COMMAND DECISION AIDING TECHNOLOGY (COMDAT) TECHNOLOGY DEMONSTRATOR (TD) OPERATOR MACHINE INTERFACE (OMI) STYLE GUIDE COMPLIANCE AND ENHANCEMENT

Unger Campbell and Associates
Gweneth Unger Campbell, Ph.D.

20520 23rd Avenue West
Lynnwood, Washington 98036

Voice: (425) 771.2394
Fax: (425) 771.2414
e-mail: gu.campbell@ungercampbell.com

Defence Research and Development Canada - Toronto
DRDC Report CR2004-129

2004 October 15

106-03189/

COMMAND DECISION AIDING TECHNOLOGY (COMDAT) TECHNOLOGY DEMONSTRATOR (TD) OPERATOR MACHINE INTERFACE (OMI) STYLE GUIDE COMPLIANCE AND ENHANCEMENT

Unger Campbell and Associates
Gweneth Unger Campbell, Ph.D.

20520 23rd Avenue West
Lynnwood, Washington 98036

Voice: (425) 771.2394
Fax: (425) 771.2414
e-mail: gu.campbell@ungercampbell.com

Defence Research and Development Canada - Toronto
DRDC Report CR2004-129

PWGSC Contract W7711-037854/001/TOR

2004 October 15

The scientific or technical validity of this Contract Report is entirely the responsibility of the contractor and the contents do not necessarily have the approval or endorsement of Defense R & D Canada.

© Her Majesty the Queen as represented by the Minister of National Defence, 2004
© Sa majesté la reine, représentée par le ministre de la Défense Nationale, 2004

ABSTRACT

This report describes the results of a review of the Command Decision Aiding Technology (COMDAT) Technology Demonstrator (TD) Operator-Machine Interface (OMI) and describes its compliance with the COMDAT OMI Style Guide. The review is presented in three parts. Part one, a compliance matrix, identifies over 120 design elements of the COMDAT TD OMI that are not compliant with the COMDAT OMI Style Guide. Each of the non-compliant elements is described in the compliance matrix. The relevant paragraph (and paragraph number) from the COMDAT OMI Style Guide is identified for each non-compliant design element. Part two identifies 24 new items that will be added to the COMDAT OMI Style Guide as a result of the review. Part three covers other usability issues, identified during the review, that are not directly related to style guide items. The review notes include specific style guidance as well as other usability observations from the COMDAT TD review.

RÉSUMÉ

Le présent rapport décrit les résultats d'un examen de l'Interface opérateur-machine du démonstrateur de la technologie d'aide aux décisions de commandement (COMDAT) ainsi que la conformité de l'interface avec le guide de style relatif à l'IOM de la COMDAT. L'examen est divisé en trois parties. La première partie, une matrice de conformité, répertorie, pour l'IOM du démonstrateur de la technologie COMDAT, plus de 120 éléments de conception qui ne sont pas conformes au guide de style. Tous ces éléments non conformes sont décrits dans la matrice de conformité. Le paragraphe pertinent (ainsi que le numéro du paragraphe) du guide de style relatif à l'IOM de la COMDAT est indiqué pour chacun des éléments de conception qui n'est pas conforme au guide. La deuxième partie répertorie 24 nouveaux éléments qui seront ajoutés au guide de style par suite de l'examen. La troisième partie traite d'autres problèmes de convivialité relevés durant l'examen, qui ne sont pas directement reliés aux éléments du guide de style. Les notes d'examen comprennent le guide de style spécifique ainsi que d'autres observations relatives à la convivialité, résultant de l'examen du démonstrateur de la technologie COMDAT.

EXECUTIVE SUMMARY

The Command Decision Aiding Technology (COMDAT) project addresses the utility, usability, and operational effectiveness of Multi Source Data Fusion for Halifax-Class Canadian Patrol Frigates (CPFs).

Consistency within an Operator Machine Interface (OMI) and between OMIs contributes to the usability of any system. The design concepts developed during the second build of the COMDAT Technology Demonstrator (TD), and the OMI itself, are not completely consistent with the COMDAT OMI Style Guide or with good human factors practice. As a precursor to specifying additional enhancements to the OMI, it was necessary to conduct a formal review of the current COMDAT TD OMI.

This report describes the results of the review of the COMDAT TD OMI and describes its compliance with the COMDAT OMI Style Guide. The review is presented in three parts as follows:

- *Compliance Matrix.* The review identified over 120 design elements of the COMDAT TD OMI that are not compliant with the COMDAT OMI Style Guide. Each of the non-compliant elements is described in the compliance matrix. The relevant paragraph (and paragraph number) from the COMDAT OMI Style Guide is identified for each non-compliant design element.

- *New Style Guide Items.* The review resulted in the identification of 24 new items that will be added to the COMDAT OMI Style Guide.

- *Review Notes.* In the course of the review, usability issues were identified that are not directly related to style guide items. The review notes include specific style guidance as well as other usability observations from the COMDAT TD review.

In a final portion of this effort, not included in this report, the identified new style guide items will be incorporated into the COMDAT OMI Style Guide and posted on the DRDC Web site. The new style guidance, and identified illustrations, will be available on the DRDC Web site for the benefit of all future development of Halifax Class CPF CCSs.

SOMMAIRE

Le projet de technologie d'aide aux décisions de commandement (COMDAT) porte sur l'utilité, la convivialité et l'efficacité des opérations de fusion de données de sources diverses pour les Frégates canadiennes de patrouille (FCP) de la classe Halifax.

L'uniformité à l'intérieur de l'Interface opérateur-machine (IOM) et entre les IOM contribue à rendre les systèmes plus faciles à utiliser. Les concepts élaborés dans la deuxième préversion du démonstrateur de la technologie de la COMDAT, et l'IOM proprement dit, ne sont pas entièrement conformes au guide de style de l'IOM de la COMDAT ni aux bonne pratiques de rationalisation du travail. Avant de déterminer d'autres améliorations à apporter à l'IOM, il a été nécessaire de procéder à un examen officiel de l'IOM du démonstrateur de la technologie de la COMDAT.

Le présent rapport décrit les résultats de l'examen dont a été l'objet l'IOM du démonstrateur de la technologie de la COMDAT ainsi que la conformité de l'interface avec le guide de style relatif à l'IOM de la COMDAT. L'examen est divisé en trois parties :

- Première partie : *Matrice de conformité.* L'examen a permis de répertorier, pour l'IOM du démonstrateur de la technologique de la COMDAT, plus de 120 éléments de conception qui ne sont pas conformes au guide de style relatif à l'IOM de la COMDAT. Tous ces éléments non conformes sont décrits dans la matrice de conformité. Le paragraphe pertinent (et le numéro du paragraphe) du guide de style est indiqué pour chacun des éléments de conception non conformes.

- Deuxième partie : *Nouveaux élément du guide de style.* L'examen a permis d'identifier 24 nouveaux éléments qui seront ajoutés au guide de style de l'IOM de la COMDAT.

- Troisième partie : *Notes d'examen.* Au cours de l'examen, on a relevé des problèmes de convivialité qui n'étaient pas directement reliés aux éléments du guide de style. Les notes de l'examen comprennent des éléments spécifiques du guide de style ainsi que d'autres observations sur la convivialité, résultant de l'examen du démonstrateur de technologie de la COMDAT.

Dans un des derniers volets du projet, qui ne fait pas partie de ce rapport, les nouveaux éléments ont été définis; ils seront intégrés au guide de style relatif à l'IOM de la COMDAT et affichés dans le site Web de RDDC. Le nouveau guide de style et les illustrations indiquées seront accessibles sur le site Web de RDDC pour le développement ultérieur de systèmes de commande et de contrôle pour les Frégates canadiennes de patrouille de la classe de Halifax.

TABLE OF CONTENTS

ABSTRACT/ RÉSUMÉ.....i
EXECUTIVE SUMMARY ii
SOMMAIRE iii
TABLE OF CONTENTS iv

1 INTRODUCTION 1
2 PREVIOUS EFFORT 2
3 CURRENT EFFORT.....3
4 RESULTS 5
5 SUMMARY STATEMENT 9

ANNEX 1: COMPLIANCE MATRIX A1
ANNEX 2: NEW STYLE GUIDE ITEMS A2
ANNEX 3: REVIEW NOTES, VERSION 2.0 .....A3

1 INTRODUCTION

The Command Decision Aiding Technology (COMDAT) project addresses the utility, usability, and operational effectiveness of Multi Source Data Fusion for Halifax-Class Canadian Patrol Frigates (CPFs).

Consistency within an Operator Machine Interface (OMI) and between OMIs contributes to the usability of any system. For COMDAT development the necessity for consistency is particularly pressing. The operators will be able to transfer their experience across a variety of systems without incurring additional training expenses or making unnecessary errors due to differences among the OMIs.

Review of the COMDAT TD for compliance with the COMDAT OMI Style Guide is part of an effort to assist the development of the TD. By encouraging consistency in the OMI, the COMDAT TD team can build on existing usability knowledge while at the same time the team can develop new and effective decision aids for the operators. Adherence to a single style guide will encourage the development of a common look and feel throughout the CPF CCS.

2 PREVIOUS EFFORT

One of the work items carried out under the COMDAT project was to develop and demonstrate an improved OMI for use with the TD on Naval Tactical Display (NTD) technology in an evolutionary development. In support of the development of the TD, Unger Campbell developed an OMI style guide that was compatible with both the interface style that operators learn using the existing CCS, and with existing military OMI style guides. The COMDAT TD project requirements specify that the newly developed COMDAT TD OMI be consistent with the COMDAT OMI Style Guide.

To further support the COMDAT project, in addition to the development of a COMDAT OMI style guide, Unger Campbell was contracted by DRDC-Toronto to complete a three-part effort prior to the work that is reported here. Each of the earlier three parts addressed the consistency and usability of the COMDAT OMI. The three parts of that effort were as follows:

- Unger Campbell developed examples of how a typical tactical display might look if it were compliant with the COMDAT OMI Style Guide
- Unger Campbell evaluated a set of concepts for representing uncertainty on the tactical display
- The original version of the COMDAT OMI Style Guide was translated into HTML format to make its contents more readily accessible to users

Although adherence to identified styles is consistent with good usability design, it does not substitute for good human factors and usability practice. A user-centered design process integrated into the system engineering process, coupled with attention to design consistency as identified in the COMDAT OMI Style Guide, will result in a more effective and useful system design than either effort alone.

3 CURRENT EFFORT

In parallel with the work described in *Section 2: Previous Effort*, new design concepts were being developed by Lockheed-Martin and implemented in a COMDAT TD. The new designs added the output from MSDF to the current CCS tactical picture, integrate the wide area picture as provided by GCCS-M and Link-11 with the Ownship tactical picture, and allow the operators to access and manipulate this additional information. The initial design of the OMI for the COMDAT TD deviates substantially from the current tactical display.

The design concepts developed during the second build of the COMDAT TD, and the OMI itself, are not completely consistent with the COMDAT OMI Style Guide or with good human factors practice. As a precursor to specifying additional enhancements to the OMI, it is necessary to conduct a formal review of the current COMDAT TD OMI. The intent is to identify inconsistencies between the COMDAT TD OMI and the COMDAT OMI Style Guide so that these inconsistencies can be addressed. The ultimate goal is to provide the operators with an interface that is consistent with the COMDAT OMI Style Guide and with good human factors practice.

The formal review reported here is comprised of three parts as follows, each of which is described in more detail in the following paragraphs:

3.1 COMDAT TD Review
3.2 COMDAT OMI Style Guide Compliance
3.3 Additions to the COMDAT OMI Style Guide

3.1 COMDAT TD Review

In an initial step in the usability review, Unger Campbell attended the contractors' facility and was provided with a thorough walk-through of the current state of the COMDAT TD OMI. The walk-though was intended to familiarize Dr. Campbell with the details of the OMI design and its utility to the operators.

The walk-though provided the basis for an initial report delivered to DRDC-Toronto entitled *Review of the COMDAT TD for Compliance with OMI Style Guide and Update of the OMI Style Guide: Initial COMDAT Review Notes*, Unger Campbell, 6 February 2004 (Version 2.0 of the Review notes is presented in *Annex 3: Review Notes, Version 2.0*).

3.2 COMDAT OMI Style Guide Compliance

In the second part of the current effort, Dr. Campbell reviewed the COMDAT TD OMI design and compared the design to each item of style guidance in the COMDAT OMI Style Guide [Version 1.0] available on the DRDC Web site (URL: http://www.drdcrddc.dnd.ca/researchtech/projects/hsi/library/documents/comdat_style_guide_e.html) The focus of the review was to identify areas where the COMDAT TD can be improved by ensuring consistency with the COMDAT OMI Style Guide. The review identified over 120 elements of the COMDAT TD design that are inconsistent with the style guide.

The relevant paragraphs of the COMDAT OMI Style Guide and a description of non-compliant design elements are presented in *Annex 1: Compliance Matrix*.

3.3 Additions to the COMDAT OMI Style Guide

In addition to identifying areas of the TD that will benefit from being compliant with the COMDAT OMI Style Guide, the review of the COMDAT TD designs revealed design elements that are not addressed in the style guide. The review also revealed one element of the current style guide that is not consistent with the new research on uncertainty displays. In the final portion of the current effort, new style guide items were developed and will be added to the COMDAT OMI Style Guide. Recommendations to change existing style guidance are also presented. A set of illustrations is being prepared to enhance the text of the COMDAT OMI Style Guide. The selected set of illustrations has not yet been confirmed.

Descriptions of 24 identified new style guide items, and the recommended change of existing style guidance, are presented in *Annex 2: New Style Guide Items*.

4 RESULTS

The current report addresses the following three areas regarding the COMDAT TD and the COMDAT OMI Style Guide. Each of these is described in more detail in the paragraphs that follow:

4.1 *Compliance*. Identify specific elements of the design that are not compliant with the COMDAT OMI Style Guide.
(See *Annex I: Compliance Matrix*.)

4.2 *Identify changes to the style guide*. Identify any alterations to the COMDAT OMI Style Guide that reflect effective design elements in the COMDAT TD OMI. Also presented separately are observed usability issues from the COMDAT TD walk-through presented as a series of notes.
(See *Annex 2: New Style Guide Items* and *Annex 3: Review Notes, Version 2.0*.)

4.3 *Amend the Style Guide*. Amend the COMDAT OMI Style Guide with changes in guidance, or with the addition of illustrations, that will be of benefit both to the users of the style guide and to operators of future systems. These amendments will be provided in a fourth Annex in the final version of this report and will be incorporated into an updated HTML version of the COMDAT OMI Style Guide to be posted on the DRDC Web site.

4.1 Compliance. Identify specific elements of the design that are not compliant with the COMDAT OMI Style Guide

4.1.1 *Overview.* Specific elements of the COMDAT TD design that are not compliant with the COMDAT OMI Style Guide are identified and were recorded in a compliance matrix. The compliance matrix for the COMDAT TD is presented in *Annex 1: Compliance Matrix*. The matrix identifies 123 areas where the COMDAT TD can benefit by re-design so as to be compliant with the COMDAT OMI Style Guide.

4.1.2 *Scope of the COMDAT TD.* The COMDAT TD development is part of the NTD and is limited in scope by requirements to retain some aspects of the NTD displays. The compliance matrix takes into account limitations in scope but is not restricted to those design features that are solely part of the new TD.

4.1.3 *Organization of the Compliance Matrix.* The COMDAT OMI Style Guide provides guidance for a wide scope in CCS support. The relevance of the style guide is not limited to the current CCS or to the current build of the COMDAT TD. Only those elements of the style guide relevant to the current build of the COMDAT TD OMI are included in the compliance matrix.

The compliance matrix is divided into four columns as follows:

Column 1: Compliance. The Compliance column places each design feature in one of two categories as follows:

- *Not compliant*
- *Confirm that the feature is compliant*

The categories of compliance are designated *No* and *Confirm* in the first column of the matrix.

A third category: *Out of scope* may be applicable. Identifying the design features that may be out of scope of the contractor's effort is not within the scope of this report. Any instances in which the government and contractor agree that an element identified in the compliance matrix is out of the scope of the COMDAT TD, that design element should be identified and reserved for consideration in future development of the COMDAT TD.

Column 2: Paragraph. Column two identifies the paragraph number of the COMDAT OMI Style Guide (Version 1.0) that is relevant to the design feature.

Column 3: COMDAT OMI Style Guide. Column 3 contains the COMDAT OMI Style Guide paragraph that is relevant to the design feature.

Column 4: COMDAT TD. Column 4 describes each identified design feature of the COMDAT TD OMI.

4.2 Identify changes to the style guide. Identify any alterations to the COMDAT OMI Style Guide that reflect effective design elements in the COMDAT TD OMI.

To ensure consistency for the operators of CPFs' CCSs, design elements emerging from the TD development, but not included in Version 1.0 of the style guide, are identified and are to be added to the style guide. Each line item in *Annex 2: New Style Guide Items* reflects the paragraph format of the style guide. The numbers for each line item in *Annex 2: New Style Guide Items* are the paragraph number for the item in Version 2.0 of the COMDAT OMI Style Guide.

To further support the COMDAT TD development, Unger Campbell provided DRDC-Toronto with an initial report containing usability observations that resulted from the review of the COMDAT TD. Some of the observations are out of scope of the current report but are included here for the benefit of the COMDAT TD development team as well as for further development projects. The usability notes are provided in *Annex 3: Review Notes (Version 2.0).*

4.3 Amend the Style Guide. Amend the COMDAT OMI Style Guide with changes in guidance or illustrations that will be of benefit both to the users of the style guide and to operators of future systems

Identified amendments to the COMDAT OMI Style Guide will be provided in a fourth Annex (*Annex 4: Amendments to the Style Guide*) in the final version of this report. *Annex 4: Amendments to the Style Guide* will contain an updated HTML version of the COMDAT OMI Style Guide suitable for posting on the DRDC Web site.

5 SUMMARY STATEMENT

Consistency within an OMI and between OMIs contributes to the usability of any system. For COMDAT development the necessity for consistency is particularly pressing. Operators using COMDAT technology will benefit from enhanced usability for the CCS. The operators will also be able to transfer their experience across a variety of systems without incurring additional training expenses or making errors due to differences among the OMIs. The COMDAT OMI Style Guide is designed to provide information that permits the developers to build on existing design solutions and usability knowledge while at the same time create new and effective tool for the operators.

The current report describes three parts of a process designed to support the COMDAT TD development. Identified areas of compliance with the COMDAT OMI Style Guide will assist the development team in identifying and remedying non-compliant design elements. New style guidance, and enhancement of the COMDAT OMI Style Guide, resulting from the review will support the COMDAT TD development as well as direct further development of all CPF CCSs.

ANNEX 1: COMPLIANCE MATRIX

1 Introduction			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
1.3 APPLYING THE WINDOWS STYLE GUIDE			
No	1.3	...The platform with which most Canadians are familiar is Microsoft® Windows. For Canada, it was decided to direct development to the Microsoft windows styles, beginning with this COMDAT OMI Style Guide.	The COMDAT TD windows are not consistent with the Microsoft® Windows styles. Examples of inconsistencies include the widgets to close, maximize, and minimize windows.
1.5 CONVENTIONS USED IN THIS STYLE GUIDE			

1 Introduction			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
No	1.5.5	Throughout the document the provisions call for adherence to the Naval Tactical Display Symbols … Without further research only those elements of STANAG 4420 or Military Standard 2525 that correspond to the current NTDS symbols should be used by the developer at this time.	Two potential candidates for new symbology are symbology that informs the operator of the source of the track and symbology that provides the operator with certainty information regarding the track. Regarding the fused track identifier that indicates the source of the track, there appears to be no evidence that either the correct information is being presented or that the operators can easily use the symbols. New research has been conducted with CPF personnel addressing certainty symbology. See DRDC report CR 2003-*036 COMDAT Symbology and Design Study Version 2.0* Unger Campbell and Associates 15 March 2003).
1.6 DOCUMENTING THE OMI			
No	1.6	…The contractor should subject the emerging OMI designs to at least two types of evaluation …Usability Tests [and]…Quality Assurance Reviews.	The COMDAT TD does not appear to have been subjected to usability trials. The internal consistency of the displays suggests that the designs may have been subjected to informal quality assurance reviews.

2 DESIGN DECISION FILTERS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
2.2 USER SKILLS AND EXPERIENCE			
No	2.2	The controls and displays shall be designed to support the lowest anticipated operator skills. Experienced operators shall be provided with controls that bypass the support provided for inexperienced operators.	The COMDAT TD appears to be designed without focus on either the operators' physical or cognitive tasks. Experienced operators generally require less support and less visual guidance than newly trained operators. The OMI should support a range of operator experience.
2.3 PHYSICAL ENVIRONMENT			
No	2.3	• Font Size. Font sizes must be larger than is required for a normal office environment. • Cursor Targets. The shipboard environment is subject to motion; accordingly the pointing device and on-screen target areas for the cursor must be large so that fine motor control is not required.	Font sizes are too small to be read under normal operational conditions. E.g., the font sizes for the tabular displays are too small to be read. Similarly, some targets are too small to be accessed (e.g., the scroll bar in the alerts areas).

4 INPUT DEVICES			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
4.3 THE POINTER			
No	4.3.1.15	When a system uses multiple physical displays, the pointer shall move between multiple displays when users move the pointing device.	In the COMDAT TD the operator must use the keyboard to switch between the two screens rather than being able to move the cursor directly between the two screens via the pointer control.

5 WINDOWS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
5.1 SYSTEM WINDOWS			
No	5.1.1.4	A digital clock shall be displayed to the right end of the COMDAT status bar, showing the Date/Time Group.	COMDAT TD does not show the required digital clock.
No	5.1.1.5	An alert (and messages) indicator (to notify the operator that alerts are present) is displayed on the left end of the COMDAT status bar.	COMDAT TD does not have an alert indicator in the COMDAT status bar.
No	5.1.1.6	The notification of an alert [in the status bar] shall indicate the priority of the alert, if available.	COMDAT TD does not have an alert indicator in the COMDAT status bar.
No	5.1.1.7	The contents of an alert (and message) shall be displayed in an area dedicated for that purpose near and below the alert notification indicator.	Alerts are shown in the lower left hand corner of the COMDAT TD display rather than near and below the alert notification indicator on the COMDAT status bar.
No	5.1.1.10	The COMDAT status bar shall contain an area to display the operator position(s) selected by the user upon login.	The COMDAT TD does not display the operator position in the COMDAT status bar.
No	5.1.2.1	The Title Bar and Window Border of classified windows shall be colour coded to display classification status. A window showing detailed classification information shall be available upon selection of the classification status.	The title bar and window border of the TD system should be green to indicate unclassified windows.

5 WINDOWS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
5.2 PRIMARY WINDOWS			
No	5.2.1.3	The name of the application shall be left justified next to the window menu button icon.	The name of the COMDAT TD application is currently centered rather than being left justified.
No	5.2.1.4	The right side [of the title bar] shall contain manipulation tools with minimize, maximize, and close buttons as the minimum manipulation tools.	The *maximize* and *minimize* buttons in the TD are on the right side of the title bar as required, however the *close* button is on the left. The windows containing the tabbed data (e.g., MSDF specific Pedigree Data) should have the capability to be closed from the title bar.
No	5.2.4.1.2	Fixed windows shall be automatically loaded upon system initialization and cannot be closed or minimized	The tactical display is a fixed window; the *close* and *minimize* buttons should be removed.
No	5.2.4.1.3	Fixed windows cannot be re-sized or re-located by the user.	It is recommended that fixed windows in operational systems should not be able to be re-sized or moved by the operator. The tactical display on the COMDAT TD should be amended so that the operators cannot re-size or move the window.
5.3 SECONDARY WINDOWS			
No	5.3.1.7	The name of the application shall be left justified to the end of the window menu button, followed by a colon and then the file name.	The names of the applications are not left justified to the end of the window menu buttons.

5 WINDOWS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
5.3 SECONDARY WINDOWS continued			
No	5.3.1.8	The right end of the window title bar shall contain manipulation tools with a *close* button as the minimum manipulation tool.	Confirm that secondary windows (such as error messages) have, at minimum, a *close* button at the upper right hand corner. The secondary windows containing MSDF-specific information, such as the Pedigree Data, do not have the required title bars or the controls associated with title bars.

6 DESIGN GUIDANCE			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
6.4 DESIGNING WINDOWS TO MINIMIZE MEMORY LOAD			
No	6.4.1	Users shall be able to perform the task called for in a window without referring to external information.	The operators can determine the information they require from the MSDF display but they must refer to the set-up screen to see what has been selected.
6.5 WINDOW MODALITY			
No	6.5.7	If a modal window is used it shall contain all of the information necessary for the operator to make the decision.	Error messages do not contain all of the information necessary for the operator to make the required decision. The message should include enough detail for the operator to identify and correct the error.
6.6 WIDGET SELECTION			
No	6.6.1	Radio buttons shall be used when selecting an option from up to six mutually exclusive options.	Radio buttons are to be used when the operators are presented with up to six mutually exclusive options.
No	6.6.5	If the operator must select a numeric value then the following shall be used [as appropriate] Scale or counter for continuous values within a range, Standard Combination Box for a standard set of values normally selected, Drop-Down Combination Box for a standard set of values normally selected and there is a need to conserve space.	Avoid the necessity for operators to key in numbers. E.g., there is no provision for a selectable track list for the operators to un-suppress a track. The operator must find the track number, remember it, and re-enter it by hand.

6 Design guidance			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
6.6 WIDGET SELECTION continued			
No	6.6.15	Vertical scroll bars shall be provided if the list is longer than the viewable list box area. Horizontal scroll bars shall be avoided if possible. A horizontal scroll bar shall only be used if most items in a list are considerably shorter than a few longer items and screen space is limited.	The COMDAT TD uses horizontal scroll bars to display the tabbed information in the MSDF Pedigree Data display. The information should be organized and displayed without the need for horizontal scroll bars.

7 WINDOWS NAVIGATION AND SELECTION			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
7.3 OBJECT SELECTION			
No	7.3.3.3	The <Return> key shall invoke the default action in a window if the focus is on an object other than multi-line text.	Ensure that the <Return> key invokes the default action in the window. In some instances pressing <Return> does not invoke the default action. E.g., pressing <Return> does not close the Remote Platform amplification window.
No	7.5.5.9	Users shall be required to correct only an invalid action and not to repeat the entire sequence. The system shall permit correction of individual errors without requiring re-entry of correctly entered commands or data elements.	The COMDAT TD error recovery process requires that the operators re-enter all of the data, not just the entries that are incorrect.

8 CONTROLS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
8.1 CONTROL CHARACTERISTICS			
No	8.1.1	All of the types of controls in a window shall be identifiable solely based on their appearance.	Not all selectable objects have appropriate three-dimensional appearance. E.g., Quick Action Buttons (QABs) do not have appropriate shadowing: selected buttons have the same shadowing as non-selected buttons.
No	8.1.5	Grouped controls shall be framed and shall be clearly labeled to indicate the functions they perform.	COMDAT OMI grouped controls are not framed to indicate their group. E.g., Quick Action Buttons (QABs) are not delineated in functional groups.
8.2 CONTROL ACTIONS			
No	8.2.2	Very frequent or safety-critical tasks shall be identified and shall be accomplished with a single operator action such as a keystroke or button press.	Frequent or safety-critical tasks for the COMDAT TD have not been identified. E.g., is not clear whether selection of MSDF filters or checking the sources of a fused track, or both, is expected to be frequent tasks.
No	8.2.3	Frequent or critical tasks shall be identified and shall be accomplished with no more than three operator actions (keystrokes, button presses, etc.)	The COMDAT TD has not identified frequent or safety-critical tasks for the COMDAT system.
8.3 CONTROL AREAS			
No	8.3.3	Controls for operations that are potentially destructive shall not be co-located with frequently used or confusable controls.	The *DROP RDB TRK* Quick Action Button (QAB) is co-located with *DSPL RDB TRK* QAB.

8 CONTROLS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
8.5 PUSH BUTTONS			
Confirm	8.5.2.5	Push button minimum size shall be as follows … Empty button: at least 0.20 inches in both height and width…A Quick Action Button (QAB) button shall be sufficiently large for three lines of readable text (8-10 char. per line) or two lines of text plus a colour bar; at least 0.70 inches in both height and width.	Confirm that all buttons, including the buttons that are associated with the alarms, or that open sub-menus, are of ample size.
No	8.5.3.2	Push button labels shall be short and unambiguous and the label shall be mixed case with the first letter of each word capitalized (book title capitalization).	The labels on the push buttons are not mixed case. Buttons that are improperly labeled include specific COMDAT TD designs (such as the Clear Alarm buttons) as well as the Quick Action Buttons (QABS).
No	8.5.3.7	Push button labels with multiple references shall include the name of the object/element. For example, a Select All button for map symbols is better labelled *Select All Symbols* to make the reference clear.	It is not possible to determine if the *Clear Alarm* selection button clears visible alarms, selected alarms, or all alarms. The label should be reviewed and the intent of the button made clear.
8.10 LIST BOXES			
No	8.10.2.9	List items shall be selectable by both the pointer and the keyboard. Lists can allow for either mutually exclusive selection or multiple selections.	The COMDAT TD does not support multiple selections. E.g., the operator cannot select all of the suppressed tracks and un-suppress (or restore) them

9 MENUS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
9.2 MENUS ORGANIZATION AND GROUPING			
No	9.2.2	The limit on the number of levels is determined by the number of actions required to activate an option. No matter where the operator is in the menu hierarchy, the operator shall be able to access any function with only three actions (e.g., one press to get back to the main level, one press to select the proper group of functions, and one press to select the desired function).	The COMDAT TD critical and frequent tasks require too many steps to complete. E.g., to get to the MSDF array from the remote screen the operator must enter a minimum of three button presses. Similarly, backing out requires at least four steps.
No	9.2.4	When menu traversal can be accomplished by clearly defined hierarchical paths, the user shall be given some indication of the displayed menu's current position in the overall or relevant structure (e.g., an optional display of path information or cascading menus).	The COMDAT TD provides the operators with little guidance regarding hierarchical paths. E.g., reviewing a sector and then dropping a sector is not supported by any visual guidance. The operator must know that the *Review* button has to be pressed 4 to 5 times even though the button display shows that the button is already pressed.
No	9.2.6	A function shall be provided to directly recall the initial, top-level menu or display without stepping through the menu or display hierarchy.	Operators cannot directly access the top-level menus throughout the COMDAT TD displays. E.g., accessing top-level menus via the *Array Select* QAB requires multiple steps.

9 MENUS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
9.4 MENU WORDING, ORGANIZATION, AND AVAILABILITY			
No	9.4.1.2	Options shall be worded in the vocabulary of users rather than that of application developers or other populations.	The COMDAT TD tends to use developers' language rather than operators' language. E.g., a QAB labeled *RDB* (Remote Data Base) is in developers' language rather than operators' language, as is *Pedigree* in the MSDF display.
No	9.4.3.9	Less frequently executed options and destructive options shall be at the bottom of the menu.	The tabs and other menus should be organized according to criticality or frequency of use.
No	9.4.4.2	If an option is only temporarily unavailable, it shall be displayed in the menu but dimmed to indicate that it cannot be selected. The dimmed function remains visible to indicate or confirm that this option does exist but is not available due to the status of the system.	When the content underneath a tab is empty, the tab in the MSDF display should be grayed out to indicate that there is no further information.

10 WINDOWS STATES, COMPONENTS, AND OPERATIONS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
10.2 WINDOW COMPONENTS			
No	10.2.2.1	A window title shall appear in the title bar of a window.	Not all of the non-fixed MSDF windows have the required title bars (E.g., the MSDF Pedigree Data window).
No	10.2.3.1	The Microsoft® Windows styles shall be followed for the design and implementation of title bar buttons, controls, icons, and locations.	Windows that can be closed should include the Microsoft® Windows controls. E.g., the MSDF Pedigree Data window.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
2.1 DATA DISPLAY AND ENTRY CHARACTERISTICS			
No	12.1.1.6	Default values shall be used to reduce user workload. Defined default values shall be displayed automatically in their appropriate data fields with the initiation of a data entry transaction and the user shall indicate acceptance of the default.	COMDAT TD has not yet systematically determined default values or states.
12.2 DATA ENTRY AND MANIPULATION			
No	12.2.1.24	If the length of information being entered in a text field varies, the text field shall be as long as the longest possible entry.	The COMDAT TD text fields are not appropriately sized for the data to be entered. Most of the text fields are fixed at 80 characters regardless of the expected length of the data to be entered.
No	12.2.1.28	Data that are known or can be computed shall be automatically entered in a field.	Within the COMDAT TD appropriate information is not automatically entered.
No	12.2.1.32	Routine or default data shall be automatically entered in a field. If this data could produce a detrimental effect, it shall not be automatically entered or must be confirmed by the operator.	Appropriate information to be automatically entered has not been identified.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY			
No	12.3.1.1	Multi-coloured text shall not be used as a code to sort data.	Multi-coloured text is used to sort data. E.g., in the tables under the tabs in the MSDF Pedigree window the headings that differentiate the information are coded by colour.
No	12.3.1.2	Multiple colour-codes shall not be used unless the colours are already associated with specific meanings.	The colour codes in the COMDAT TD displays are used to convey multiple meanings. E.g., the table headings in the MSDF Pedigree window use red and green to convey new meanings. The colour codes for labels versus contents are not consistent throughout the windows.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.1.3	Every third or fifth row of data shall be separated by a delimiter. The delimiter may include light background shading in groups of three to five rows (similar to old-fashioned computer paper), separator lines, or other means consistent with the application.	The large tables are not divided either by content groups or by rows. E.g., the *Platform* tab in the Remote Data Base display is not divided visually according to the name of the platform (a natural delimiter). If a natural delimiter is not available then the table should be separated visually by groups of rows.
No	12.3.1.5	Justification rules shall be followed: Left-justify alphabetic data; right-justify integers; justify decimal data on the decimal point.	Alignment is not consistent. E.g., the filter values are not correctly aligned. The numbers should be vertically aligned on the purported decimals for easy comparison. The labels should also be vertically aligned and left-justified for easy visual scanning.
No	12.3.1.10	Only data essential to the users' needs shall be displayed.	The COMDAT TD displays data that are not essential to the operators. E.g., the details of the contributors and non-contributors to the MSDF Correlate display, and the language of the threat platform in the Generic properties of the MSDF Generic display.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.1.11	Data presented to the user shall be in a readily usable and readable form such that the user does not have to transpose, compute, interpolate or mentally translate into other units, number bases, or languages.	The track quality on the MSDF Uncertainty display requires undue translation to be useful.
No	12.3.1.12	A text window shall be wide enough to display an entire line of text without scrolling. Text windows shall be no wider than 40-60 characters.	The text windows that indicate the Specific properties of the MSDF contact do not display the entire line of text without scrolling.
No	12.3.1.16	The operator shall be given visual cues for unacceptable entries, required entries, and the location of the present entry field.	Data queries that require operator entry do not provide enough information to prevent errors.
No	12.3.2.1	Data fields shall be organized by sequence of use, frequency of use, or importance.	Data fields are not organized by sequence of use, frequency of use, or importance. E.g., the Pedigree Data tabs, and their contents, are not organized according to expected operator usage.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.2.3	Sets of data that are associated with specific questions or related to particular functions shall be grouped together to signify those functional relationships.	The data are not grouped in functional categories. E.g., the Bearing and Range are not visibly a group, similarly the tabs in the MSDF Pedigree Data are not separated visually into groups (Data versus Properties).
No	12.3.2.5	Data fields shall be organized with related fields together and unrelated fields separated.	The layout of the data fields does not place related fields together. Examples of such arrangement for the tabular displays are available in the COMDAT OMI Style Guide illustrations.
No	12.3.2.10	Data fields with values that cannot be changed shall be displayed in a read-only information area.	The operator guidance boxes (alerts) in the COMDAT TD are displayed as data-entry boxes even though they are actually read-only. Data-entry fields should be visually distinct from read-only fields.
No	12.3.3.1	It is essential for successful operations that text displayed to the operators shall be legible and readable under operational lighting conditions and at over-the-shoulder viewing distances.	The information, particularly underneath the tabs on the MSDF display, is too small to be read even at standard desktop distances.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.3.3	Readability is the ability to recognize groups of letters or words that have contextual meaning. If the letter, word, or line spacing of text is too close, user will have trouble recognizing words. If the spacing is too large, reading performance will slow. The text line length also determines the speed and ease of reading. Contextual text shall be readable.	The content of the fields is not always readable. E.g., the font for the list of possible aircraft types in the MSDF Display is too small and is not sufficiently visually separated or organized.
No	12.3.3.13	Sans serif fonts shall be used for all text displayed.	The fonts in the MSDF Pedigree Data tabs are serif fonts and should be changed to sans serif.
No	12.3.3.18	The text in each window shall be of sufficient size to be legible by users when they are at an over-the-shoulder viewing distance from the screen.	The font is not sufficiently large to be legible by operators.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.4.5	If a label pertains to a group of text, this group of text shall be offset from the rest of the text by an outline or spacing. If an outline box, or separator line, is used, the label shall be integral with the outline box or separator line.	The labels for the text are not always placed within the outline of the group of text boxes (e.g., the Generic Properties tab in the MSDF Generic display).
No	12.3.4.6	Labels shall be simple, concise words or phrases in terms familiar to the operator.	The *ARRAY SEQ* QAB serves as a *Back* button. The button can be labeled "Back" rather than have the operators learn and remember the more complicated label.
No	12.3.4.9	If text fields' labels appear to the left of their text fields, text field labels shall use a colon (:) to separate the label from the text field.	Colons do not define the labels for text fields.
No	12.3.4.11	Text labels of more than one word shall not be run together, nor shall they be separated by an underscore, or any delimiters other than a single space.	The displays use an underscore in the text labels. E.g., the Platform Names in the Remote Data Base amplification displays use underscores. The underscores should be replaced by single spaces.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.4.14	A text field label of a text field shall include cues regarding expected format of the entry.	The text fields for the data entry do not contain sufficient information (e.g., the data entry for a track number does not clearly indicate whether the leading letter should be entered, nor which of the leading letters (fused or not) is expected.
No	12.3.4.18	Labels shall be visually distinct from other text and the accentuating technique shall be different and easily distinguished from the method used to highlight or code emergency or critical messages.	Labels are not consistently coded within the displays. In some instances labels are yellow and bold; in others they are not.
No	12.3.5.1	All standard text and columns of text shall be left justified. All lines of text shall be wrapped to fit in the provided text window even if this window is resized. …	The numbers in the Filter values should be vertically aligned on the purported decimals for easy comparison. The labels should also be vertically aligned and left-justified for easy visual scanning.
No	12.3.5.4	Numeric data without decimals shall be right justified. Numeric data with decimals shall be justified on the decimal point.	Numeric values are not consistently justified. E.g., filter values and Bearing and Range are not justified appropriately.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.5.5	Labels in columns shall be left justified with the associated alphanumeric text being left justified after the longest label. Labels shall be positioned to read left to right and/or top to bottom. Labels shall be of approximately equal length to facilitate associating the label with the text field.	Labels are not consistently aligned. The labels should be vertically aligned and left-justified for easy visual scanning.
No	12.3.7.1	When displaying numbers the number zero shall have a slash through it so it is not confused with a capital "O". The letter L and the digit 1 shall also be displayed so as not to be confused with each other.	The COMDAT TD does not use a slash through the zeros to distinguish them from the letter O.
No	12.3.7.7	Graphic presentation aids interpretation. When graphic presentation of numbers positively impacts operational effectiveness, then numbers shall be presented graphically.	Graphic enhancement has not been implemented in the COMDAT TD. E.g., the level of hostility presented in the Properties tab could benefit from enhancement with graphics.
No	12.3.9.1	Titles and major headings shall be presented in book title case.	Titles and major heading are presented in all upper case rather than in book title case.

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.9.2	Use of all uppercase letters shall be reserved for acronyms and security classification banners.	Use of all uppercase letters is used throughout the display rather than being reserved appropriately.
No	12.3.9.5	All sentences and lines of text shall be presented in a combination of upper and lower-case letters, following standard capitalization rules. Mixed case type is recommended as it results in faster word recognition, especially in sentences.	All text is presented in all capitals rather than in mixed (sentence) case. E.g., in the error messages all text is in upper case.
No	12.3.10.2	Acronyms and abbreviations shall be used only if shorter than the full name and only if understood by users.	The COMDAT TD uses new acronyms that reflect the system engineering rather than the operators' understanding of the displays.
No	12.3.10.4	Abbreviations shall be meaningful, recognizable, and used consistently.	*Platform* is sometimes used as an abbreviation for a subset of Platforms and sometimes refers to GCCS alone. The term should be used consistently.
No	12.3.10.8	A dictionary shall be available (e.g., in Help) for decoding abbreviations and acronyms.	No computer-based help to decipher acronyms is available

12 DATA DISPLAY AND ENTRY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
12.3 DATA DISPLAY continued			
No	12.3.11.2	Where items in a list are displayed in multiple columns the items shall be ordered vertically within each column.	The potential contact types (e.g., Aircraft types) are listed in a horizontal row within the columns and are difficult to read.
No	12.3.11.4	Tables shall provide sorting on all sortable columns through the column heading.	Identification of appropriate columns for a sorting function has not been conducted. Columns are currently not sortable.
No	12.3.11.15	Tables shall be arranged to show similarities, differences, trends, or relationships. Depending on the task, data may be arranged in sequential, spatial, alphabetical, functional and/or chronological order.	The tables in the Pedigree Data tabs do not appear to be arranged to reveal similarities, differences, trends or relationships. The data should be rearranged to support the operators' tasks.
No	12.3.11.16	Data that are important, require immediate response, and/or are frequently used, shall appear at the top of the table.	Data that are important are not consistently placed at the top of tables. E.g., the track identifier on the tabbed pages should be at the top so that the operator can confirm the correct track is being displayed.

13 SPECIAL FUNCTIONS AND FORMATS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
13.2 DATE/TIME AND LATITUDE/LONGITUDE			
No	13.2.1.2	Time shall be presented to and supplied by the operator in the HH:MM:SSZ (09:38:30Z) format. HH is the hour in a 24-hour day, MM is the minute with a leading zero if necessary, and SS is the second with the leading zero if necessary. Z is the time zone with Zulu time as the default. The seconds are optional. All colons are required and the Zulu (Z) shall be capitalized.	The COMDAT TD OMI does not display the Date - Time group (DTG). The DTG should be displayed in the format described here.
No	13.2.1.3	The display shall include Zulu time and local time; Zulu time shall be presented above local time.	The COMDAT TD does not display the time.
No	13.2.1.4	The date time group shall be presented on the COMDAT status bar on the right-hand edge	The COMDAT TD does not display the time.

13 SPECIAL FUNCTIONS AND FORMATS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
13.2 DATE/TIME AND LATITUDE/LONGITUDE continued			
No	13.2.1.8	The latitude label may be abbreviated to Lat. Latitude shall be presented … All symbols are required if preceded by a number and the hemisphere (N or S) shall be capitalized. A hyphen may be substituted for the degree and minute symbols DD-MM-SS.T (09-06-30.3) The system should know in which hemisphere it is located and use this as the default value.	The latitude is presented with decimals rather than hyphens (or degree and minute symbols). In addition, the label is presented in upper case rather than mixed case.
No	13.2.1.9	The longitude may be abbreviated to Long. Longitude shall be presented to, and supplied by, the operator in the … The hemisphere (E or W) shall be capitalized. A hyphen may be substituted for the degree and minute symbols DDD-MM-SS.T (090-06-30.3). …	The latitude is presented with decimals rather than hyphens (or degree and minute symbols). In addition the label is presented in upper case rather than mixed case.

14 GRAPH DISPLAY			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
14.6 MANIPULATION AND CREATION OF GRAPHICAL DATA			
No	14.6.2.1	The system shall provide a set of appropriate drawing tools. Whenever drawing tools are provided they shall use the icons and options described in the Microsoft® Windows user guides.	The tool for drawing the sectors is not consistent with Microsoft® Windows; the tool also requires an unacceptably large number of steps.
No	14.6.2.3	Objects shall emerge as they are drawn.	The drawn objects (such as sectors) are not visible throughout the drawing process.
No	14.6.2.7	When a user must draw figures, computer aids shall be provided for that purpose (e.g., templates, tracing techniques, stored forms).	Stored templates and forms for repeated drawings (such as sectors) are not provided. E.g., no template or overlay is provided for sector definitions that are used frequently.

15 Tactical Graphics			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
15.1 TACTICAL GRAPHICS CHARACTERISTICS			
No	15.1.1	Colour shall only be used when it will increase operator performance or situational awareness.	Green is used to convey too many meanings. E.g., green is used in tables to identify information not used to create a fused track and is also used to display a fused track. Determine which uses of the colours will support the operators' tasks.

16 MAPS AND SITUATION DISPLAYS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
16.2 TACTICAL DISPLAYS			
No	16.2.1.8	Labels shall be able to be applied to any object on the tactical display. … Only the originator and authorized operators may alter global labels.	Operators cannot create labels within the COMDAT TD.
No	16.2.2.1	Controls that affect the tactical display map, such as range selection and overlays, shall be located in an area just below the Tactical Display.	Controls that affect the tactical display map are not located just below the situation display (tactical display).
No	16.2.2.6	Bearing and range lines shall display the bearing and range (in that order) near the bearing and range line approximately 1/3 of the distance between the two points and closest to the second point chosen.	Bearing and range lines are not implemented in the COMDAT TD.
No	16.2.2.7	The display of bearing and range lines shall be operator-selectable as in an overlay.	Overlays displaying bearing and range lines are not available to the operators in the COMDAT TD.
No	16.2.2.12	An operator shall be able to select a contact, input a time duration and bearing (default to current bearing) and the software will provide a predicted location for that contact assuming its bearing does not change.	The COMDAT TD does not provide the operators with a display of predicted locations.

16 MAPS AND SITUATION DISPLAYS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
16.2 TACTICAL DISPLAYS continued			
No	16.2.3.2	New drawing tools and symbols shall be provided if required. Such tools shall provide the operator with easy means to draw the required tactical objects.	The sector-drawing tool is unique to the COMDAT TD and is not sufficiently easy to use.
Confirm	16.2.3.5	When line or figures must be drawn to represent numeric coordinates, computer aids shall include templates for entering the coordinates, and if necessary, selecting the appropriate units for those coordinates.	Confirm whether the drawing tools (e.g., to draw sector lines) provide appropriate support for the operators.
No	16.2.3.6	Where graphic data must be plotted in predefined standard formats (e.g., target areas on maps), templates or skeletal displays shall be provided for those formats to aid data entry.	The COMDAT TD does not supply templates for the repeatedly drawn elements (e.g., drawing of sectors).
No	6.2.4.1.2	Users shall be able to hook a track by placing the pointer over the symbol and performing a select. A contact that is hooked shall be placed in the visual "foreground" such that no other contacts obscure it or partially cover it.	A hooked track does not move to the foreground in the COMDAT TD.

16 MAPS AND SITUATION DISPLAYS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
16.2 TACTICAL DISPLAYS continued			
No	16.2.4.2	… The capability to step through overlapping tracks is necessary, but not sufficient. An auxiliary visual cue (e.g., making the hooked contact appear brighter for a period after it is hooked) shall be implemented.	Hooked tracks in the COMDAT TD do not themselves change to indicate that they are hooked.
No	16.2.4.2.2	Users shall be able to select a single object on a map within a densely packed group of objects. When a graphical item is selected, it shall be highlighted. If appropriate to the application, users may reposition selected elements on the display.	No graphical objects, other than tracks, can be hooked on the COMDAT TD displays.
No	16.2.4.2.3	Symbols other than contacts, such as special points or Identify Friend/Foe (IFF) symbols, are highlighted in the same manner as contacts.	No graphical objects, other than tracks, can be hooked on the COMDAT TD displays.
No	16.2.4.3.1	Amplifying information for any hooked object is provided via the same amplification area and pop-up windows used for contact information.	No graphical objects, other than tracks, can be hooked on the COMDAT TD displays.
No	16.2.4.3.2	The contact amplification window shall be a fixed window.	The contact amplification window for MSDF tracks is not a fixed window.

16 MAPS AND SITUATION DISPLAYS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
16.2 TACTICAL DISPLAYS continued			
No	16.2.4.3.3	The system shall contain a contact amplification window that displays the object information. The operator shall be able to select what amplification information is displayed.	The contact amplification window is not operator selectable.
No	16.2.4.3.4	A contact amplification pop-up window shall be able to be toggle on and off for both hooked and pre-selected contacts through their respective amplification windows. When the pre-select pop-up window is on, it shall be displayed when the object is pre-selected. The hooked pop-up window may be displayed on selection as determined by the operator.	The COMDAT TD does not support pop-up amplification windows.
No	16.2.4.4	A data block is a special case of amplification. A data block shall contain basic information about a hooked object. Data blocks are used to provide a view of the essential information about objects on the display without requiring that the operator take eyes off of the tactical picture display.	The COMDAT TD does not support data blocks.

16 MAPS AND SITUATION DISPLAYS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
16.2 TACTICAL DISPLAYS continued			
No	16.2.5.1.1	The user shall be able to place the pointer in the location of a group of symbols and successively hook each symbol in a specified range without moving the pointer. As the user presses the sequence function, the next symbol in the group shall be selected. Contacts shall be sequenced in the same order as their layering, with top contacts being sequenced first.	The COMDAT TD hooking algorithm does not cycle through layered tracks.
No	16.2.10.3	Map symbols shall not overlap. Where overlapping symbols are unavoidable a means shall be provided for moving background symbols to the foreground or otherwise revealing masked symbols.	The track numbers in MSDF tracks overlap and are unreadable by the operators.
No	16.2.11.16.1	Contact uncertainty may be displayed to show the operator the system's confidence in the contact information. The range of uncertainty may be displayed as the maximum and minimum or within a certain confidence interval. The most effective uncertainly displays are intuitive.	The COMDAT TD display of uncertainty has been the subject of new research that indicates that the COMDAT TD uncertainty bars are not intuitive.

16 MAPS AND SITUATION DISPLAYS			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
16.2 TACTICAL DISPLAYS continued			
Confirm	16.2.11.16.2	Speed uncertainty may be depicted by a multi-thickness speed leader. The thickness of a standard speed leader is tripled in the uncertainty range of the contact's speed.	The method of indicating speed uncertainty described here has not been implemented in the COMDAT TD. This style guidance is contraindicated by recent research and will be amended in the COMDAT OMI Style Guide.
Confirm	16.2.11.16.3	Location uncertainty may be depicted by an ellipse around the contact symbol with spokes joining it to the contact symbol through the uncertainty area. Error bars may be used instead of a complete ellipse; however, this shall only be done if the ellipse is a circle. The error bars shall be perpendicular to the bearing of the contact.	Location uncertainty is displayed as an ellipse around the contact symbol in the COMDAT TD; compliance the other COMDAT OMI Style Guide requirements has not been confirmed.
No	16.2.11.16.4	Bearing uncertainty may be depicted by an umbrella over the speed leader.	COMDAT TD has not opted to use the umbrella symbol to depict uncertainty regarding speed of the contact.

17 COLOUR			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
17.1 COLOUR GUIDELINES			
No	17.1.2.4	In a dark adaptation environment then the dark colour set (See Appendix IV: Windows Colours and Appendix V: Tactical Display Graphics) shall be tailored for optimized usability under the specific lighting conditions.	COMDAT TD has not been optimized for dark adaptation conditions. The background colours for the tabular displays are not consistent with the colour guidance presented in *Appendix IV: Windows Colours* of the COMDAT OMI style guide.
No	17.1.2.5	Users shall be able to select from between colour sets: One set shall be provided for each of the lighting conditions in the operations room (e.g., normal operations room lighting and dark adaptation lighting).	COMDAT TD has not developed two colour sets.
No	17.1.3.5	Red shall be used to alert the operator that application/process is inoperative until corrective action is taken.	COMDAT TD OMI uses Red in the MSDF correlate data display to indicate whether information contributed to the MSDF track. Adding meanings to a colour code unduly burdens the operators.
Confirm	17.1.3.7	Black shall not be used as the background for colour-coded items.	Confirm whether the COMDAT TD situation displays are presented on a black background.
No	17.1.3.9	Symbology shall be colour coded using conventions including the following unless superseded by NTDS or other explicitly specified symbology conventions: …Neutral = Green.	The remote tracks are presented in green regardless of whether the contacts are neutral, friend, unknown or hostile.

17 COLOUR			
Compliance	**Paragraph**	**COMDAT OMI Style Guide**	**COMDAT TD**
17.1 COLOUR GUIDELINES			
No	17.1.4.12	Colour used in predefined message windows shall only be used in the symbol/icon and shall not be used for text.	Coloured text is used to label the alarm windows and to distinguish between the label and content in the tabular displays. Coloured text should be avoided.
No	17.1.4.13	If colour is used to convey meaning, it shall be used redundantly and shall not be the only coding technique.	The only visual cue as to which sector is being reviewed is the colour of the sector on the display. Colour should not be the only cue. An alternative could be to highlight the selected sector with a bold line.

ANNEX 2: NEW STYLE GUIDE ITEMS

Annex 2 is divided into three parts as follows:

- **A2-1 New Style Guide Items**
- **A2-2 Removal of Existing Style Guide Items**
- **A2-3 List of Style Guide Amendments**

A2-1 New Style Guide Items

An item number and a paragraph number identify each of the new style guide items; the paragraph number is in **bold** font. The item number refers only to the unique item number in this annex. The paragraph number in **bold** font refers to the paragraph number in the COMDAT OMI Style Guide where the item will be found. The source of each of the style guide paragraphs listed here is UCA (Unger Campbell and Associates): COMDAT TD.

A2-2 Removal of Existing Style Guide Items

Unger Campbell also recommends that paragraph number 16.2.11.16.2 of the COMDAT OMI Style Guide (*Speed uncertainty may be depicted by a multi-thickness speed leader. The thickness of a standard speed leader is tripled in the uncertainty range of the contact's speed.)* be removed from the style guide. The paragraph is contraindicated by the results of the recent Symbology and Design Study conducted by Unger Campbell on behalf of DRDC (DRDC Report CR 2003-036: *COMDAT Symbology and Design Study, Version 2.0* Unger Campbell 15 March 2003.) In that study it was determined that the CPF operators who participated in the study viewed larger symbols or fuller symbols as representing MORE certainty. The style guidance in paragraph number 16.2.11.16.2 describes thicker leaders as representative of LESS certainty.

While larger objects are generally perceived as more important than smaller objects, there appears to be a conflict between representations of certainty and importance. Unger Campbell recommends that increased size in symbols be reserved to draw attention to important information (such as errors or dangerously low ammunition reserves) rather than to convey certainty. For displays of certainty, larger symbols are intuitively interpreted as conveying more certainty and newly developed symbology should be consistent with the operators' intuitive mental models.

A2-3 List of Style Guide Amendments

1. **1.2.3** When the operators must make similar decisions, the decisions shall be supported in the OMI within the same logical model. Source: UCA; COMDAT TD
   (UCA Note: For example, models to filter information can be described in two ways. One model is described as filtering information out, the other is to pass information through. To avoid confusion, the OMI must be consistent with a single model.)

2. **12.2.1.37** Actions that affect the items on the situation display (or tactical display) shall provide visual feedback to the operator that the action was completed as intended.
   Source: UCA; COMDAT TD

3. **16.2.11.16.5** Graphics conveying uncertainty shall use fuller (or larger) symbols to represent higher levels of certainty; less full (or smaller) symbols shall be used to represent less certainty.
   Source: UCA; COMDAT TD

4. **16.2.11.16.6** Display of uncertainty shall be consistent with the recommendations resulting from the most current applicable research.
   Source: UCA; COMDAT TD

5. **8.5.2.7** The colour of the face of buttons shall be one colour when the button is pressed and a different colour, or shade, when the button is not pressed. The colour differences shall be sufficiently distinct to be easily discriminated by the operator and shall be consistent with the colour guidelines in this style guide.
   Source: UCA; COMDAT TD

6. **6.1.4** Groups of windows with similar functions (e.g., a group of alert windows) shall be ordered by frequency of usage, with the most frequent at the top.
   Source: UCA; COMDAT TD

7. **7.5.5.11** Error messages shall first state the problem followed by a statement of appropriate solutions.
   Source: UCA; COMDAT TD

8. **9.2.8** The display of information accessed by tabs [menus based on an index card tab concept] shall not include more than one layer of tabs.
   Source: UCA; COMDAT TD

9. **9.2.9** The display of information accessed by tabs [menus based on an index card tab concept] shall clearly indicate which tab is selected. The selected tab shall appear to be in front of the remaining tabs.
   Source: UCA; COMDAT TD

10. **9.2.10** When a tab is selected the outline of the selected page shall appear in front of the remaining pages.
    Source: UCA; COMDAT TD

11. **5.2.1.8** Operational controls (e.g., QABS) shall be treated as fixed windows and shall not be obscured or covered within the display.
    Source: UCA; COMDAT TD

12. **12.3.2.16** Information shall be presented (or requested) only to an operationally valid level of detail (tactical significance); unnecessary detail shall be removed from the display.
    Source: UCA; COMDAT TD

13. **12.3.7.10** Values of zero shall not be left blank but shall instead be presented as zeros.
    Source: UCA; COMDAT TD

14. **12.3.7.11** Missing or unknown values shall not be left blank but instead shall be displayed with place markers such as periods or dashes.
    Source: UCA; COMDAT TD

15. **12.2.1.37** When operators access information in order to alter the data, the window shall initially show the current state of the information.
    Source: UCA; COMDAT TD

16. **12.2.1.38** Data entry shall be supported by standard widgets that facilitate data entry and avoid keyboard entry by the operators. Examples include widgets such as spin boxes for numbers and calendars for dates.
    Source: UCA; COMDAT TD

17. **12.2.1.39** Widgets implemented to support data entry (e.g., spin boxes for numbers and calendars for dates) shall not replace the manual entry of data.
    Source: UCA; COMDAT TD

18. **6.2.3.8** The OMI shall support direct manipulation of displayed objects on the situation display. Examples include selecting drawn objects and moving or dropping them.
    Source: UCA; COMDAT TD

19. **12.3.3.42** All labels, text, and titles, acronyms, words and headings shall be spelled correctly.
    Source: UCA; COMDAT TD

20. **12.3.3.43** All terms shall be used consistently throughout the OMI. Examples include underlying definitions such as "best quality" from different sensors for local and fused data, terms such as "Platform", and actions such as "clear alarms".
    Source: UCA; COMDAT TD

21. **12.3.11.19** Tables or other displays that contain similar data shall be easily visually distinguished by the operators.
    Source: UCA; COMDAT TD

22. **6.2.8.9** Underlying geo-information system or other maps placed on the situation display shall not interfere with the primary (contact or track) information.
    Source: UCA; COMDAT TD

23. **6.2.10.13** Track numbers shall be displayed with both of the two most recent track numbers when track numbers are updated frequently.
    Source: UCA; COMDAT TD

24. **15.1.15** The display shall provide a visual distinction between system-generated and manual upgrade of a track.
    Source: UCA; COMDAT TD

25. **Remove** paragraph **16.2.11.16.2** Speed uncertainty may be depicted by a multi-thickness speed leader. The thickness of a standard speed leader is tripled in the uncertainty range of the contact's speed.

ANNEX 3: REVIEW NOTES

A3-1 INTRODUCTION

This Annex represents the initial effort of the review process. The notes reported here include issues related to the specific Navy domain, human factors principles, and the COMDAT OMI style guide. Attention to each of these areas will have a positive impact on the operational success of the COMDAT TD OMI.
These notes are reported in three sections as follows:

- **A3-1 Introduction**
- **A3-2 High Level Impressions**
- **A3.3 Detailed Observations**

A3-2 HIGH LEVEL IMPRESSIONS

2.1 Complexity

The primary and overwhelming impression is that the controls and displays are too complex for operational use. The impression is of a system that was designed to reflect and provide access to the underlying technology, rather than to enhance the ability of the operators to complete their missions successfully.

2.2 Source Display Design Solution

2.2.1 *Overview*. The Lockheed Martin team has recently developed a simple display (for convenience, in this report the display is called the Source display). The Source display shows the operators which sensor contributed to any hooked track. That display is currently designed as a horizontal box divided into sections to represent each of the sensors. In the design, the sensors that contribute to a hooked track are highlighted. The operator can tell *at a glance* which sensors contributed to the fused image of that track. The Source display is a likely candidate to be one of the most useful features of the MSDF display. By referring to the Source display, and using their knowledge of the characteristics of the various sources, the operators can deduce the reliability as well as any likely delay of the contributing feeds.

2.2.2 *Enhancements*. If the Source display were enhanced by adding a limited number other features, then the Source display might well be able to provide many of the critical features needed by the operators. Examples of such enhancements follow:

2.2.2.1 View Source Tracks. The most potentially useful feature is a control that permits the operator to view all of the contributing tracks for each hooked track. In this instance the operator would then see the MSDF track surrounded by the "sensor truths" from the contributing sensors.

2.2.2.2 Control Sensors. The operators might benefit from the capability to control the input from the sensors from the source display. Essentially they would be able to turn on or off specific sensors (the necessity for such a feature is arguable and subject to confirmation from the operators) or select other features such as range (again, the necessity for such controls are arguable and subject to confirmation).

2.3 Tabular Displays

The tabular displays are far too complex to be useful to the operators. Without question the tabular displays provide more information than will be of use to the operators. The information is presented in a fashion that makes it difficult to read. Finally, the information is not organized so that information that is useful is in a primary place within the tables.

2.4 Situation Display

The tracks on the situation display that indicate the selected filters and those that describe fused data cannot be interpreted *at a glance*. The current displays are likely to create operator error because the operator cannot easily discern (without reading the letter identifier on the track number) the type of track and whether the track is a threat. Further, the track number from the fused data overlays the original track number, making it nearly impossible to report a track or to refer to a track efficiently and quickly.

2.5 Filter Selections

While the MSDF filter selections reflect the realities of the filter parameters and algorithms, it is not clear that the way in which the operators select the filters supports the decisions being made by the operators. The information that drives the operators' choice of filters is not clear. The design may be better able to support the operators' decisions regarding filters once the information requirements are clearly defined.

2.6 Properties (or Propositions)

A potentially valuable tool may be a tool that describes the properties regarding the platform from which a track originates. The value of the tool is currently lost due to its presentation. The critical information is lost in the presentation of too much information. If the derived allegiance and category of a track, for example, provide added value to the operators, then that information must be displayed so that it can be obtained *at a glance*. Effective design solutions are likely to include details such as a more prominent location on the display and an improved design that shows the probabilities graphically. An example of an enhancement using graphics is to provide horizontal bar graphs that show the absolute and relative probability of the options.

2.7 Summary

The current MSDF displays appear to reflect the research community's requirements rather than the operator's requirements. While the displays and controls do permit the tasks to be completed, the designs are not focused on the operators' tasks or missions. In an operational environment the effectiveness of the MSDF would benefit significantly, and be very useful to the operational effectiveness of the ship, with modifications to the display concept that are consistent with good human factors principles within the operational context.

A3-3 DETAILED OBSERVATIONS

Notes: The pages and screen titles identified in the following observations refer to screen shots and nominal locations of screens and are referenced here for the convenience of the author. Observations associated with a particular screen shot (or page) are not limited to that screen on the displays. These observations will be taken into consideration as part of the next phase of this contract and are reported here as notes.

This section includes 103 identified issues.

3.1 **Inconsistency.** The setting of the filters is inconsistent. In one instance the operators set the filters to determine what will *not* pass to the MSDF display, whereas in another instance the operators set filters to determine what *will* be displayed. It is essential to determine how the operators intuitively think of these functions and to match the displays to the operators' mental models.

3.2 **Setting Filters.** The operators set filters without the benefit of sufficient visual confirmation that they have achieved the desired filtering. The display would be improved with an *at a glance* capability to confirm the operators' selections.

3.3 **Filter Requirements.** There is a high probability that the some operators will not be aware that the tracks must meet all of the filter requirements before they will be passed to the MSDF display. The effect of the filters should be reinforced by a visual confirmation that the selection is as the operator intended.

3.4 **Selection of Pictures.** The operators can select from among three types of fused pictures—local or two global selections. It is not clear which distinctions among the types of pictures will be meaningful to the operators. Any useful distinctions among the types of pictures should be identified with an appropriate user trial.

3.5 **Time Late Bar.** The time late bar is a small graphic that indicates a delay in the track report. As the delay increases the bar increases in size. A larger bar indicates less certainty. In research conducted with actual operators, the operators interpreted fuller symbols as representing more certainty. In this display, a larger bar indicates less certainty and so is counter-intuitive and is likely to cause errors of interpretation.

3.6 **Time Late Bar.** The time late bar is divided into thirds. The result is that some representation of the time is present whenever the feature is selected. The presence of the symbol at all levels, as opposed to having the absence of the symbol represent one level of the information, is consistent with good human factors principles.

3.7 **Titles and Labels.** The colour of the titles should be consistent throughout the interface. The title of the alarms is green yet many other titles are yellow.

3.8 **QABS on GCCS-M (upper monitor).** When the operators are working with the GCCS-M displays the QABs are not functional. These QABs should be grayed out to indicate that they are not available to the operators.

3.9 **Alarms**. The alarm titles are bright green inverse video when selected and their content is also green. Elsewhere the titles are yellow. All titles and labels should be consistent.

3.10 **Alarms**. It is not possible to determine if the "clear alarm" selection clears visible alarms, selected alarms, or all alarms. The label should be reviewed and the intent of the selection made clear.

3.11 **Tactical Alarms.** There are several sets of alarms on the display. The most important to the operators are the tactical alarms and they should be moved to the top of the alarm set.

3.12 **Clearing Alarms**. The labels for clearing the alarms in the different alarm types are not consistent or clear.

The following notes were derived from the CCRO Page

3.13 **Language**. The RDB (Remote Data Base) label on the QAB is not in the users' language. "Remote Data Base" is the developers' language and should be changed to reflect the utility to the operators instead of the technical reality.

3.14 **Contrast**. The background colour and the label on the QABs are not distinct enough so that the QABs can be easily read.

3.15 **Co-Location.** Latitude/Longitude should be co-located.

3.16 **Co-Location**. Bearing/Range should be together.

3.17 **Critical Features.** The operators cannot distinguish among the critical features of the tracks. All tracks are green in this display. The operators will be unable to focus visually on the tracks of interest. Consider whether the friendly tracks should be made less prominent visually. Examples include using dotted lines or less intense colour shading.

3.18 **Track Quality.** A green ellipse shows the area of uncertainty around a track. Uncertainty ellipses have not proven to be operationally successful in other command and control systems. The uncertainty ellipses may prove useful for this application, depending on the complete context of the design. The uncertainty ellipse, as used here, does include both a visual ellipse and the numbers associated with the uncertainty. Reinforcing the graphic with the numbers is an effective design choice.

3.19 **Naming Conventions**. Throughout the interface the naming conventions reflect the technical reality rather than the operators' mental models. The names are non-informative and potentially confusing. Careful attention to the choice of names will result in reduced cognitive load and reduced training time required for each new operator. Examples of current names that can be altered to reflect the operators' mental models include the following: Close Control Read Out (CCRO), Data Amplification Read Out (DARO), Operator Guidance Read Out (OGRO), and Ownship Read Out (OSRO). The new names should be distinctive and intuitive.

3.20 **Track Block.** The operators are required to hook each track in order to access amplifying information regarding that track. In many air defense and air traffic command and control systems the operators can choose to display track blocks for selected tracks of interest. If track blocks are implemented, they should have transparent backgrounds so as not to interfere with the operators' view of the Situation Display. Other features of track blocks include determining for this application whether they are more effective if co-located with the track symbology, moved to a corner of the display, moveable by the operators, or shown associated with the track by anchor lines.

3.21 **Error messages.** Throughout the design, error messages should be re written so that they are informative to the operators'. The error messages should identify the problems and suggest solutions. In the error messages the identification of the problem should be meaningful to the operator, rather than a statement of the underlying technology. For example, if the operator attempts to hook Ownship using the "DSPL RDB AMPL" access, the current error message is "Invalid track". Having made the error, the operator gets no further information from the error message regarding the correct course of action. A more useful message would be "Hook a remote track". Even further, the message should briefly state that the operator cannot hook Ownship. All error messages should specify a correct action.

3.22 **RMT RDB AMP Tab**. It is difficult to tell which data is on any single line.

3.23 **RMT RDB AMP Tab**. The amplification data shows all of the information from the GCCS console. There is far more information presented than the operators will find useful. The critical and frequently-used information should be identified and the remaining information be removed from the display.

3.24 **Graying out**. When there is no content underneath a tab, the tab should be grayed out so that the operator does not search for data that is not there. By graying out unavailable tabs, or tabs which have no underlying content, the operators' workload is reduced considerably.

3.25 **Layered Tabs**. The tabs in the displays, that permit the operators to select amplified data, are layered. There should not be more than one layer of tabs.

3.26 **Dropping a Track**. The "DROP RDB TRK" QAB is co-located with "DSPL RDB" track. There is a possible source of error by having the Display and Drop buttons located together.

3.27 **Access to Controls**. The tabs overlap the QABs. If the operator is using the tabs, then the QABs; which control the critical actions of the system, are not accessible.

3.28 **Operator Guidance Box**. The operator guidance boxes (alerts) appear to be data-entry boxes even though they are actually read-only. Data-entry fields should be visually distinct from read-only fields.

3.29 **Error Messages.** All error messages should provide the operators with a description of the correct action. An example of a current error message for the range rings is "Illegal Entry". A better message would be "Enter a number between 0 and 512 DM".

3.30 **Acronyms**. The defense world is acronym intense. New acronyms should be introduced carefully and unnecessary acronyms should be avoided. When operators are familiar with acronyms, the acronyms can be used freely. Newly introduced or less familiar acronyms should be accompanied by their spelled out titles.

The following notes were derived from the Remote Filter Page

3.31 **Filters**. The operators filter out the characteristics that they *do not want* to appear on the MSDF display. It may be more effective to permit the operators to select the display of tracks based on the characteristics that they *want*.

3.32 **Filters**. Because the underlying technology for the MSDF selection is a filtering algorithm, the design permits the operators to filter out information. Currently, when the filter is turned on the user does not see the item. If the filters are renamed to describe what is passed through them, then the intuitive relationship between *On* and *Obtaining the Effect* can be obtained.

3.33 **Cursor Focus.** When the operator receives an error message, the current design correctly places the cursor focus on the appropriate data entry field to facilitate entry of the revised data.

3.34 **Terms**. When working to determine which tracks will be passed to the MSDF engine the term used is *upgrade*. The term *upgrade* is not a sufficiently salient term. Care should be taken to create new terms that are intuitive and meaningful to the users. The new terms should reflect the users' goals.

3.35 **Steps**. There are too many levels of filters to make the MSDF process simple and effective. The operators must decide what is passed through the initial filter and then what subset of that information will be displayed. Following those selections, the operators must then decide which of the available images they need to see on their displays. The number of stages introduces opportunity for errors. The operators may well filter out critical tracks and be unaware that they have done so. Further, it requires a large short-term memory load to determine what is and is not being displayed. The operators need an ability to easily see and control what is being displayed on their screens.

3.36 **Time Filter.** The time filter requires far too many steps to set. The operators must step one field at a time, through days, hours, minutes, and seconds. Determine the detail of filter that is necessary—are seconds necessary, are days necessary? Once the actual parameters have been decided, permit the operators to enter the entire set at one time.

3.37 **Time Filter.** The instructions to the operators when entering the time filter include one to the effect of "If null, hit return". The instruction is not clear and should be revised; consider whether a null value should simply be the default value and be shown as 0.

3.38 **Time Filter**. The time filter is an example of a filter that inappropriately does not provide the operator with the current state. If an operator opens the filter all of the fields are blank and the operator cannot confirm the current state nor change just the state of interest. All such filters should show the current state.

3.39 **Data Entry**. The operators have not been provided with standard widgets on the time filter that facilitate data entry and reduce errors. Such widgets include spin boxes and calendars. These widgets should supplement manual data entry, not replace it.

3.40 **Alignment**. The filter values provide an example of misalignment of the values and labels. The numbers should be vertically aligned on the purported decimals for easy comparison. The labels should also be vertically aligned and left-justified for easy visual scanning.

3.41 **Capitalization**. Acronyms should be in upper case; most other words should be in book title case. Sentences should be in sentence case. Avoid the use of all capital letters (except when appropriate, as with acronyms). Text and labels written in all capital letters are difficult to read.

3.42 **Drawing Tools**. Drawing the sectors requires an understanding of the tool and of the relationship between the shape of the sector and the start and end points. The tool also requires that the operator be aware that the sectors cannot overlap. Consider supplementing the drawing tool with the ability to grab the corners of the drawing directly and move it to the desired place without starting a new figure.

3.43 **Direct Access.** To remove a sector from the display the operator must select the "DSPL/DELE Sector" QAB, review the sector, and then drop it. Reviewing the sector requires cycling through "Start", "Stop", "Bearing", and "Range", then a blank value. To remove a sector the operator must cycle through all 5 steps and then press the "Drop" button.

Users of software systems are familiar with direct actions. The number of steps to remove the sector drawing can be reduced if the operator can simply hook the sector object and press "Drop".

3.44 **Review a Sector.** The capability to review a sector and then drop a sector is not supported by any visual guidance. The operator must know that the Review button has to be pressed 4 to 5 times even though the button display shows that it the button is already pressed.

3.45 **Colour**. The only visual cue as to which sector is being reviewed is the colour of the sector on the display. Colour should not be the only cue. An alternative could be to highlight the selected sector in a bold line.

3.46 **Two Screens.** The use of two screens may not be optimized. The upper screen displays the tracks available to the MSDF engine. The operators may benefit from seeing the tracks as part of the entire situation picture before determining the filtering process. The information that drives the filter choices by the operator is not clear. Once those information requirements are defined the display may be better able to support the process.

3.47 **Manual and Automatic Upgrade.** The distinction between a manual and an automatic upgrade of a track is not clear.

3.48 **Track History**. The track history displays the last report. Operators would benefit from a visual display of the data trail.

The following notes were derived from the Lower Screen

3.49 **MSDF Array.** For training purposes the operator may need to display more than one MSDF array. It is important to ensure that the operator has visual confirmation regarding which screen is being displayed.

3.50 **Default Values**. The operator must select the "DSPF CPF TRKS" QAB to view the current unfused situation display. The unfused data is likely to be the selection most commonly used by the operators at this time and should be available as a default.

3.51 **Local Source**. Selection of Local Source results in a display from the same sensors as the QAB "DSPL CPF TRKS" and the labels should be matched. The local tracks should be referred to by a single title such as Local Source, CPF Tracks, or other language that is consistent and not confusing.

3.52 **Definition of Best**. There is an apparent inconsistency between the solutions provided by different sources. The local tracks prioritized by the best sensor whereas the fused data prioritizes tracks by the best output. The MSDF does not factor in the best sensor. This difference in the definition of quality may cause difficulties in operators' interpretations.

3.53 **Track Numbers.** The track numbers are identified by the fusion source. If the fusion source is important enough to be displayed for each track then it should be presented so that the operators can tell the source more easily.

3.54 **Track Numbers.** The profusion of track numbers for different purposes is a likely source of delay in communicating information, at the very least. At worst, the proliferation of track numbers may cause a safety critical error in track identification.

3.55 **Track Quality.** The track quality is presented in a set of numbers, such as 044/00.202/00.02. Fine detail presented in a long series of digits is not useful. The track quality should be presented in a visual display that does not require mental arithmetic and is interpretable at a glance. Meaningful and easily interpretable numbers can supplement the visual display.

3.56 **Update the Time**. In the time update, if "day" is important, determine whether the reference to "this day" or "yesterday" is required.

3.57 **Global 1 and Global 2**. The distinction between Global 1 and Global 2 displays may not be important if the tabular displays show a list of the sensors that contribute to a track. The list of sensors can be separated into three groups: Local, GCCS and Link sensors and the users can tell at a glance which sensors are on and which contributed to the fused track.

3.58 **Coloured Track Numbers.** Coloured text is difficult to read. The optimum colour choices for text are black letters on a light background, followed by light letters on a dark background.

3.59 **Colour Codes.** Multiple colour codes are difficult for users to remember. Colour codes often do not have intrinsic or intuitive meaningfulness. Unless the colour codes are intrinsically or historically meaningful they should be avoided. Examples of historically meaningful colours include Blue for Friendly and Red for Hostile. Multiple colour codes interfere with the operators' tasks and introduce visual clutter in the display.

3.60 **Radio Buttons**. When the operators can only select one option from a set of options, radio buttons are the design of choice.

3.61 **Labels**. The "ARRAY SEQ" QAB serves as a Back button. The button can be labeled "Back" rather than have the operators learn and remember the more complicated label.

The following notes were derived from the MSDF Filters Page

3.62 **On Versus Off**. When the MSDF buttons are "Off" the operator sees all of the data. The operators might find the concept of a Pass rather than a Filter more intuitive. With a Pass, "On" means that they would see the information rather than "On" meaning that they will not see the information.

3.63 **Default**. There is an inconsistency between the remote filters and the MSDF filters displays. In the remote display controls, the default is that all of the filters are on (and they are backlit) so nothing goes through to the MSDF engine. In the MSDF controls the default is off (and the filters are not backlit) and everything is displayed. The most effective default values should be determined and the displays should be consistent.

3.64 **Amplification**. Under the" DSPL MSDF AMPL" button, is a set of multiply layered tabs. Tabs should not be presented in more than one layer.

3.65 **Tabs**. The tabs are designed so that it is not possible to easily determine which tab is selected. The outline of the selected tab should extend past the remaining tabs and the selected tab should be in a visible colour or bold font, depending on the details of the design.

3.66 **Track Identification**. The label at the bottom of the tab pages identifies the track. The track identifier should be at the top so that the operator can confirm it is the correct and expected track.

3.67 **Horizontal Scroll.** Under some of the tabs the information is so extensive that horizontal scroll bars are required. Do not use horizontal scroll bars.

3.68 **Font**. The text in the tables is far too small to read.

3.69 **Font**. Throughout the displays a sans serif font should be used. Serif font is preferred only for paper versions and should be avoided on screen displays.

3.70 **Labels**. The label "Platform" is ambiguous and is used to denote two different things within the design. In some instances it refers to the GCCS only, in other instances it refers to more than one platform.

3.71 **Colour of Details**. In the large amplification tables information, used to create the fused data, is presented in red whereas data available but not included in the fusion algorithm is presented in green. It is doubtful whether the level of detail presented here is of interest to the operators. If however, it is necessary then at the very least the colour codes should be restricted to the top of the column, not be extended throughout the column and the title should indicate which type of data is which.

3.72 **Differences**. The Lat/Long from the platform information does not match the Lat/Long of the fused data. Of interest is whether the operator would refer to the information at all and if so is the interesting detail the distance between the two locations or the actual Lat/Longs? If the operator will be calculating the distance then that calculation should be provided. If on the other hand, the operator will report the actual position then the position should be provided.

3.73 **Volume of Data**. In the various amplification tables the number of column varies (about 24 under the "Platform" tab, 12 under the "ESM" tab and 9 under the "SPS49" tab). Clearly this is far more information than will be used by the operators. If information is necessary for the scientific community it should be presented in a more usable manner (including placing the most important data in the left-most columns) and placed so that it does not interfere with the operators' tasks.

3.74 **Pedigree**. If the list of what information was used is necessary then it should be re-labeled and the contents should be presented so that the most important information is easily derived from the display. Consider whether to combine Pedigree and Correlate tables.

3.75 **Specific Prop(erties).** The MSDF algorithms will provide a derived identification of the originating platform. The tab should be re-labeled to reflect the operators' own language.

3.76 **Specific Properties**. Determining the likely platform from which a track is launched may be valuable for the operators, particularly operators with less experience. The layout of the Properties tab obscures the critical information.

The information in the properties tab is suited to a visual display. If the percentages were displayed as horizontal bar graphs the operators could tell *at a glance* the primary information: probability of Friend or Hostile and the strength of the probability.

3.77 **Detail**. Information that is not adding value should be removed from the display. Examples may include displaying the likely language of the hostile forces.

3.78 **Colour cues.** In the Specific Properties, each value is presented as a percentage. There may be an operational advantage if the values over the threshold amount are shown in bold font, or if graphically displayed, in brighter colours. Additional colour cues, as currently designed, do not add to the information and do detract from the display.

3.79 **Colour Values.** Determine the meanings of all colours used within the entire system. Currently, for example, green is used for far too many meanings. Colour use should be reduced so that colour works as an enhancement, or to support visual grouping, rather than to convey multiple meanings.

3.80 **Distinctive Appearance**. The tables for Pedigree and Correlate look sufficiently similar that the user may inadvertently select the incorrect tab and be unaware of the error. When tables such as these are overly similar it is worthwhile to provide further cues to distinguish between them.

3.81 **Titles and Organization.** The title of the button that permits the operator to cancel a suppressed track should be reconsidered so as to reflect the action of Displaying the track rather than Canceling a suppressed track. It may be reasonable to include it under the category of Displaying tracks rather than as a separate cognitive event.

3.82 **Navigation through Menus.** The navigation through menus is not supported by visual cues in the interface. Most often the operators must memorize the menu structure and contents as well as the processes in order to accomplish their tasks. Processes are difficult to teach and are most quickly lost if not used frequently. Particularly in light of the frequent turnover of operational staff, the OMI would benefit from increased visual cues.

3.83 **Multiple Selections.** Currently the operator cannot select all of the suppressed tracks and "unsuppress" or "restore" them. Instead the operator must enter each one, press "Enter", Press "CNCL SUPP TRACK", and then enter the next one. The task would be simplified if the operator could select all of the tracks at once or simply check the desired tracks and then press "Restore".

3.84 **Data Entry.** Entering the track number, for example in order to cancel a suppressed track, will result in operator error. Whenever possible aids should be provided so that the operator can select, or check, options rather than enter the data by hand.

3.85 **Design Induced Errors.** Entering a track number to un-suppress a track will cause operator error. The interface provides the cue that the operator can enter the track number as L#### or G####. It is not clear whether the operator should enter the identifying letter. It should be made clear whether the letter identifier should be entered.

3.86 **Display of Track Numbers**. There is an inconsistency between the displays of the track number. If the operator enters the track number as it is displayed on the MSDF alarm system (for example: GZ####) the system will return an error message. The Z that is part of the track number is not accepted at this point in the interface. The system will also return an error if the track number starts with Z. The system should display the track numbers in a consistent fashion and should accept the data as the operators use it.

3.87 **Scroll Bars**. The alarm tabular displays have sufficient room to display one alarm only. If there is more than one alarm then scroll bars appear on the right hand side of the display. The operators will not see the scroll bars; consequently the messages will not be retrieved. Users of software systems are focused on the contents of the panes, not on the controls, and so are not aware when the controls change. This is true even when scroll bars are considerably larger than those implemented here. The presence of hidden content is more readily apparent if the text is partially hidden under the "edge" of the pane.

3.88 **Overlapping Track Numbers**. Currently the local tracks and the fused track numbers are overlapping in the situation display. The overlapping of the track numbers makes it impossible for the operator to read either track number. The design solutions should not include overlapping track numbers.

3.89 **Alarms**. Remove the coloured text on the alarms.

3.90 **Colours**. The background colour for the tabular displays is a relatively bright blue. The background should be changed to either a dull gray or, to reduce glare, a dark gray consistent with the COMDAT OMI Style Guide.

3.91 **Maps**. If an underlying geo-information system or geographic map is placed on the situation display it should not interfere with the primary (track) information. Consider dimming the geographic information so that it is visible, if desired, but faded in appearance.

3.92 **Sensor Display**. As a feature beyond the scope of the earlier contract, the Lockheed-Martin design team created a Sensor Display feature. The Sensor Display permits the operator to see *at a glance* those sensors that contribute to a track. In the currently delivered prototype, the operator must navigate through a series of tabs to check for each sensor's contribution to the fused track. In the new design the team provided the operators with a simple read-only single-line bar that lists the sensors.

The label of each sensor (or sensor group) is provided in each rectangle making up the bar. If that sensor contributed to the MSDF then the rectangle is highlighted. The operator can glance at the bar to see which sensor contributed to the hooked track.

The Sensor bar can be further modified to permit the operators to see all of the sensors' returns on a particular track so that the operator can quickly check the "sensor truth" on the situation display for the track.

The Sensor bar can also be modified to reveal which sensors are not operating by displaying those sensors grayed out. To reduce clutter, the reasons for the down time do not need to be displayed.

The three critical pieces of information for the user (sensor truth, contributing sensor, sensor status) should be validated with the operational team. However this design element has the potential of providing much of the primary information visually, simply, easily, and intuitively.

3.93 **Size of Buttons**. On the remote track and MSDF CCRO the design team has created a design element that contains a drawer. The drawer provides the user with a GCCS pop-up directly from the display; as opposed to the QAB used in the current design. The concept is effective and can be enhanced by making the button larger.

3.94 **Labels**. If two screens are used (remote sensing controls and local sensor displays) then the labels for the two screens should reflect the operators' language rather than the technical reality.

3.95 **Steps**. To get to the MSDF array from the remote screen the operator must enter at least three button presses. Because this is a frequent and critical task it should be able to be accomplished with one button press. Similarly, four steps are currently requires to back out. The entire interface should be reviewed to ensure critical and frequent tasks can be accomplished with a minimum of actions. When in the remote mode, access to the filters should require no more than one action.

3.96 **Language**. The language of the interface should be reviewed for simplicity, users' language, and consistency. Currently, for example, Platform sometimes refers to GCCS alone and sometimes GCCS is a subset of Platforms.

3.97 **Buttons**. Below the set of alarms is a Close button. It is not clear from its placement whether it closes the alarms or closes the window. The referent for all buttons should be clear both from their labels and their placement.

3.98 **Hooking a Track**. It is not possible to tell which track has been hooked if two tracks are close together. The hooked track should itself become brighter or larger in order to confirm that it is indeed the hooked track.

3.99 **Uncertainty Ellipse.** The uncertainty ellipse should be carefully reviewed for utility and whether it causes confusion of interpretation. If the uncertainty can reasonably be translated into the location of the track, then the uncertainty ellipse could be re-named more simply, as a location indicator.

3.100 **Hooking a Track**. When tracks overlap the software does not currently cycle through the underlying objects. Consideration should be given to whether direct access to the underlying tracks would benefit the operators.

3.101 **Track Numbers.** The MSDF changes the track number according to the most recent information. The track number is primary information that the operators use to identify and communicate track information. The continuing changes in the track number from the MSDF are small and require constant monitoring by the operator. The changing track numbers are a potential source of error within the system.

3.102 **Specific Properties**. If the Platform information provided by the MSDF is of use to the operators, then the information should be presented so that it is easily seen and interpreted. Currently, the platforms are not arranged according to probability (due to a software bug), are too small, and require several steps to access. It is likely that the operators will already be aware of the level of threat of the platforms and so providing that information may not add value for the operators.

3.103 **Colour**. The colour codes for tracks passed through the various filters and from various sensors may be confusing rather than helpful. All of the symbol, track, and track number colour codes should be reviewed.

DOCUMENT CONTROL DATA SHEET		
1a. PERFORMING AGENCY Unger–Campbell and Associates, 20520 23rd Avenue West, Lynnwood, Washington 98036		2. SECURITY CLASSIFICATION UNCLASSIFIED –
1b. PUBLISHING AGENCY DRDC Toronto		
3. TITLE Command Decision Aiding Technology (COMDAT) Technology Demonstrator (TD) Operator Machine Interface (OMI) Style Guide Compliance and Enhancement		
4. AUTHORS Dr Gweneth Campbell		
5. DATE OF PUBLICATION October 15 , 2004		6. NO. OF PAGES 79
7. DESCRIPTIVE NOTES		
8. SPONSORING/MONITORING/CONTRACTING/TASKING AGENCY Sponsoring Agency: Monitoring Agency: Contracting Agency : DRDC Toronto Tasking Agency:		
9. ORIGINATORS DOCUMENT NO. Contract Report CR2004–0129	10. CONTRACT GRANT AND/OR PROJECT NO. W7711–037854/001/TOR	11. OTHER DOCUMENT NOS.
12. DOCUMENT RELEASABILITY Unlimited distribution		
13. DOCUMENT ANNOUNCEMENT Unlimited announcement		

14. ABSTRACT

(U) This report describes the results of a review of the Command Decision Aiding Technology (COMDAT) Technology Demonstrator (TD) Operator–Machine Interface (OMI) and describes its compliance with the COMDAT OMI Style Guide. The review is presented in three parts. Part one, a compliance matrix, identifies over 120 design elements of the COMDAT TD OMI that are not compliant with the COMDAT OMI Style Guide. Each of the non–compliant elements is described in the compliance matrix. The relevant paragraph (and paragraph number) from the COMDAT OMI Style Guide is identified for each non–compliant design element. Part two identifies 24 new items that will be added to the COMDAT OMI Style Guide as a result of the review. Part three covers other usability issues, identified during the review, that are not directly related to style guide items. The review notes include specific style guidance as well as other usability observations from the COMDAT TD review.

(U) Le présent rapport décrit les résultats d'un examen de l'Interface opérateur–machine du démonstrateur de la technologie d'aide aux décisions de commandement (COMDAT) ainsi que la conformité de l'interface avec le guide de style relatif à l'IOM de la COMDAT. L'examen est divisé en trois parties. La première partie, une matrice de conformité, répertorie, pour l'IOM du démonstrateur de la technologie COMDAT, plus de 120 éléments de conception qui ne sont pas conformes au guide de style. Tous ces éléments non conformes sont décrits dans la matrice de conformité. Le paragraphe pertinent (ainsi que le numéro du paragraphe) du guide de style relatif à l'IOM de la COMDAT est indiqué pour chacun des éléments de conception qui n'est pas conforme au guide. La deuxième partie répertorie 24 nouveaux éléments qui seront ajoutés au guide de style par suite de l'examen. La troisième partie traite d'autres problèmes de convivialité relevés durant l'examen, qui ne sont pas directement reliés aux éléments du guide de style. Les notes d'examen comprennent le guide de style spécifique ainsi que d'autres observations relatives à la convivialité, résultant de l'examen du démonstrateur de la technologie COMDAT.

15. KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) COMDAT; Multi–Source Data Fusion; style guide; operator–machine interface; technology demonstrator; design guidelines; Navy; command and control; human factors